Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 27

JELLICOE AREA

(NTS 42E/NW)

District of Thunder Bay

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ONTARIO
MINISTRY OF NORTHERN DEVELOPMENT
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John F. Gartner

1979

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MAP
(accompanying report)

Map 5077 (coloured) – Northern Ontario Engineering Geology Terrain Study, Data Base Map, Jellicoe (NTS 42E/NW). Scale 1:100 000.

Northern Ontario
Engineering Geology Terrain Study 27

JELLICOE AREA

(NTS 42E/NW)

District of Thunder Bay

by

John F. Gartner[1]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Jellicoe area, District of Thunder Bay. The area, which covers NTS block 42E/NW, lies between Latitudes 49°30′N and 50°00′N and Longitudes 87°00′W and 88°00′W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km^2 of northern Ontario.

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5077, accompanying this report).

Interpretation of existing black and white aerial photographs, at scales of approximately 1:54 000, was the primary method of obtaining this

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terrain information. The interpretation was checked with published and unpublished literature which documented previous field visits and observations. During the summer of 1978, roads in the area were traversed and almost 400 separate observation points recorded as further verification of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of this information is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed, in preparation), a companion publication to this series of maps and reports.

2.0 GEOLOGICAL SETTING:

2.1 BEDROCK:

Early Precambrian rocks underlie the entire map-area. The relief of this rock terrain is generally low to moderate, seldom exceeding 60 m. Quaternary deposits are widespread and form a mantle over much of the bedrock.

An east-trending belt of folded and faulted metavolcanics and metasediments traverses the central and southern portions of the area. Major easterly-trending faults parallel Highway 11 to the north and south, and provide a structural control to the topography. Metavolcanics are also widespread to the northwest, while felsic igneous rocks, consisting of granites, diorites, and syenites, are predominant in the northeastern part of the area (Pye *et al.* 1966).

The metasediments and metavolcanics have a high to medium potential, for the occurrence of base metals, gold, and silver. The potential of the felsic igneous rocks is rated as least to unknown (Springer 1978).

2.2 QUATERNARY:

Glacial ice advanced from the northeast and deposited till over much of the bedrock. This till is prevalent in the eastern half of the map-area, and locally reaches thicknesses of over 30 m. Well-developed drumlins occur south of Wildgoose Lake. The till in these drumlin areas appears to be calcareous in composition, with a high percentage of silt and fine sand. The till in the remainder of the map-area is coarser in texture and, locally, very bouldery.

During deglaciation, a variety of glaciofluvial landforms was deposited. Outwash sand and gravel mantle much of the till, and esker-kame-outwash complexes form southwesterly-trending deposits, especially in the southeastern part of the map-area.

When the ice had retreated to a position northeast of the map-area, meltwaters formed glacial Lake Nakina in front of the ice margin (Zoltai 1965a, 1967). However, no major glaciolacustrine deposits from this lake are evident in the area. Glacial Lake Nakina drained to the west via two major spillways: one called the *Jellicoe Spillway*, which parallels Highway 11 to Beardmore, and another some 5 km to the north. This resulted in the sandy outwash deposits observed in these localities.

These spillways emptied into another glacial lake, called Lake Kelvin, which occupied the Lake Nipigon basin. The deep and extensive glaciolacustrine clay and silt found in the northwest quadrant of the map-area were deposited in this lake.

Extensive meltwater action and glacial lake inundations have modified most of the surface deposits, resulting in a complex stratigraphy throughout much of the area.

3.0 ENGINEERING TERRAIN UNITS:

3.1 BEDROCK:

3.1.1 Description:

Rock knobs (RN) and *rock ridges* (RR) form the bedrock terrain units

shown on the map. The low to moderate relief, generally less than 60 m, results in an undulating to moderately knobby topography.

A mantle of ground moraine is associated with this rocky terrain. It is usually less than 1 m thick near the crests of the bedrock outcrops, but can thicken to as much as 3 m on the flanks and in some of the valleys between rock hills. This till is sandy in texture, and cobbles and boulders are common. A sample of till taken at Station 380 in Fulford Township contained 75 percent sand, 23 percent silt, and 2 percent clay. Localized organic deposits often occur in poorly drained areas between bedrock highs.

Typical map symbols which depict this terrain unit are:

$$\frac{\text{RN(tMG)}}{\text{Mn-M}} \qquad \frac{\text{RN(tMG,pOT)}}{\text{Mn-M}}$$

$$\frac{\text{RN(tMG/R)}}{\text{Mn-M}} \qquad \frac{\text{RR(tMG,pOT)}}{\text{Lu-M}} \qquad \frac{\text{RR}}{\text{Mjd-D}}$$

These symbols show bedrock knob terrain (RN) as dominant, with areas of deeper till (tMG), till overlying bedrock (tMG/R), or till and organic terrain (tMG,pOT) as subordinate units within the complex.

3.1.2 Significance:

RESOURCES: Portions of the rock can be used for crushed stone purposes, but detailed evaluations of suitability for aggregate use would be required. Ground water resources within the rock will be limited to fractures, faults and fissures. The occurrence of aquifers is unpredictable and the terrain has only fair potential for ground water supplies.

GENERAL CONSTRUCTION: The major constraint in terms of construction is the presence of irregular and complexly sloping bedrock outcrops. This means that below-ground excavations will probably require blasting. Site grading will be expensive and rock fills will be necessary in grading works. Foundation conditions should be excellent on the bedrock, but route alignments will require rock cut-and-fill operations.

Because of the shallow drift cover and complex rock slopes, development activities are generally more difficult, and hence more expensive, than in areas of thicker overburden. Also, management of the land for any development would be complex. The variable and sometimes steep rock slopes, combined with the shallow drift cover, mean that the terrain is prone to surface erosion, especially when cleared of vegetation.

WASTE DISPOSAL: The bedrock terrain is not amenable, in its natural state, to the disposal of waste, whether it be garbage, septic tank effluent, or industrial liquid waste. Development of lagoons or tile fields would require extensive grading of rock materials and importation of soil fill. Fractures in the bedrock could act as conduits for migration of effluents, and impact on surface drainage courses could be significant.

3.2 MORAINAL LANDFORMS:

3.2.1 Description:

Ground moraine (MG) covers much of the map-area. It can be divided into two major types 1) the drumlinized, deeper till deposits found in the southeast quadrant of the area, and 2) the thinner till deposits, covering bedrock, which occur over the remainder of the area.

The deeper, drumlinized ground moraine appears to consist of buff-coloured sandy silt till, with moderately sized stones and boulders. Samples taken at Station 12 in Lindsley Township and Station 502 in Salsberg Township were analyzed for their grain size distribution, with the following results:

	Station 12	Station 502
Sand (percent)	38	47
Silt (percent)	55	49
Clay (percent)	7	4

The sample at Station 12 contained 41 percent total carbonate. A map symbol typifying this type of deposit is:

$$\frac{\text{tmMG(pOT)}}{\text{Lrw-M(W)}}$$

Ground moraine also occurs as a thin deposit mantling the bedrock. Rock knobs and organic deposits are associated with this terrain unit. In these areas, bedrock is usually not visible, but is often close to surface. The till varies in thickness from less than 1 m to more than 5 m. The material is typically a stony and bouldery, silty sand till. Moorhouse (1938, p.4) described the till mantle in the south Onaman area as ". . . generally greyish and silty and . . . [containing] . . . varying quantities of boulders and pebbles. Its appearance suggests that it has been markedly modified by water".

Bedrock knobs and areas of shallow overburden are common, and bedrock controls the topography of the area. The washing of much of these deposits by meltwaters and shallow glacial lake action has modified the surface till and left a complex near-surface stratigraphy. Examples of terrain unit symbols which represent these conditions are:

$$\frac{\text{tMG(RN)}}{\text{Lunw-M}} \qquad \frac{\text{tMG/RN}}{\text{Luw-M}} \qquad \frac{\text{tMG/RN(RN,pOT)}}{\text{Mu-M}}$$

3.2.2 Significance:

RESOURCES: Aggregate resources are scarce where ground moraine is the dominant terrain unit. Local and confined pockets of sand and gravel may exist, especially where the till has been modified by meltwaters, but large resources of such deposits are not expected.

Groundwater resources for water supply purposes are not expected to be significant. Small aquifers may exist at depth in areas of deeper overburden, but these would be unpredictable and difficult to locate.

GENERAL CONSTRUCTION: Where the ground moraine overlying bedrock is thick, such as in Lindsley, Parent, Salsberg and Errington Townships, there should be minimal problems with general construction procedures. Problems would be encountered with earthworks in areas where large boulders occur or with the handling of excavated silty materials, especially during wet weather conditions.

In the areas of sandy and stony tills and bedrock complexes, construction problems could be more severe. In deep excavations, the probability

of intersecting bedrock would be high. The overburden materials could be diverse in texture, and strict quality control in earthworks would be required.

WASTE DISPOSAL: The ground moraine areas can be amenable to the siting of waste disposal facilities. This is especially true in the areas of deeper till. As the thickness of drift cover overlying bedrock decreases, so does the suitability of the area for waste disposal from a regional perspective. While detailed hydrogeological investigations would be required, the present reconnaissance mapping suggests that the deeper ground moraine landforms are suitable target areas for the location of landfills, septic systems, and waste treatment lagoons.

3.3 GLACIOFLUVIAL LANDFORMS:

3.3.1 Description:

Eskers (GE) and *kames* (GK), occurring in association with one another, form southwesterly-trending terrain units. They are most common in the eastern half of the map-area. The relief is usually less than 15 to 20 m, and they are not considered as massive landforms.

The materials are sand and gravel, varying from sandy gravel (gs) to gravelly sand (sg) and sand (s). In some areas, they are associated with outwash sand (sGO), and the terrain is pitted and kettled (k).

Examples of map symbols which depict these terrain units are:

$$\frac{\text{sGE,sGO}}{\text{Lruk-M}} \qquad \frac{\text{sgGK,sgGE,sgGO(RN)}}{\text{Lnkr-M}}$$

$$\frac{\text{sgGE}}{\text{Lr-D}} \qquad \frac{\text{sgGK,sgGE}}{\text{Lnr-D}} \qquad \frac{\text{sgGO,sgGK(RN)}}{\text{Lun-M}}$$

An *esker delta* (sGD) is found on the south shore of Wildgoose Lake in Lindsley Township. A water well through this delta indicates more than 10 m of coarse sand, with a static water level at 7 m below surface.

Outwash (GO) is widespread throughout the map-area. An ancient spillway channel, known as the *Jellicoe Spillway*, extends from Jellicoe westerly to Beardmore. Here, the soils are predominantly sandy in texture, although local pockets of gravel are found. At Station 68, just west of Jellicoe, a sample of cobbly sandy gravel contained 73 percent gravel and 27 percent sand. Within the same landform unit, about 5 km to the west at Station 75, the material grades much finer, with only 25 percent gravel and 75 percent sand. Inventory information from the Ministry of Transportation and Communications (MTC) indicates a number of pits in the landform, with predominantly sand resources, but some areas which are high in gravel content. MTC water well and drill hole records indicate as much as 18 m of materials overlying bedrock within the spillway. The materials appear to become finer with depth, grading into the silt range. The spillway is mapped as:

$$\frac{\text{sGO,pOT}}{\text{Luk-M}}$$

South of Sturgeon River, a complex unit of outwash mixed with ice contact kames is interspersed with rock knobs. A sample of material taken at Station 205, about 6 km southwest of Sturgeon River, shows a gravelly coarse sand with 50 percent gravel and 50 percent sand. This unit is mapped as:

$$\frac{\text{sgGO,sgGK(RN)}}{\text{Lun-M}}$$

Over much of the area, the outwash forms a veneer overlying ground moraine or bedrock. Outwash materials are a mixture of sand, gravel, till, and boulders. A typical map symbol depicting this terrain unit is:

$$\frac{\text{sGO/tMG/R(RN)}}{\text{Luw-M}}$$

In Sandra Township, on the western boundary of the map-area, a terrain unit has been mapped as:

$$\frac{\text{smGO}}{\text{Lud-D}}$$

This could represent a deltaic deposit, as suggested by Zoltai (1967).

3.3.2 Significance:

RESOURCES: Glaciofluvial landforms provide the best terrain setting for the occurrence of sand and gravel resources. In the Jellicoe map-area, these potential resources can be found 1) along the Jellicoe Spillway, 2) in the esker-kame-outwash complexes extending from northeast of Wildgoose Lake southwest through Sturgeon River to the southern boundary of the area, and 3) in scattered deposits in Walters and Leduc Townships and in the northeast quadrant of the map-area.

Ground water resources may be found in some of the deeper outwash deposits (e.g. the Jellicoe Spillway).

GENERAL CONSTRUCTION: These glaciofluvial terrain units are generally suitable for most types of construction activities. Constraints are associated with 1) areas having high water tables, 2) dewatering in deep excavations, 3) grading where the overburden is locally bouldery, such as in kame-rich areas, and 4) excavations where rock knobs are shown as part of the complex.

WASTE DISPOSAL: Normal septic system design should function properly within these landforms, but prior knowledge of ground water levels and depth to bedrock is essential. Because the soils are generally permeable, siting of landfills and liquid waste disposal facilities requires a careful analysis of the hydrogeological setting.

3.4 GLACIOLACUSTRINE LANDFORMS:

3.4.1 Description:

A *glaciolacustrine plain* (LP) is found in the northwestern portion of the map-area, west of Onaman Lake. These sediments were deposited in glacial Lake Kelvin and consist of varved silt and clay which attain thicknesses of more than 30 m in some areas. A sample taken near the confluence of Martin Creek and the Onaman River at Station 175 contained 28 percent very fine to medium sand, 64 percent silt, and 8 percent clay. The material was non-plastic. In this locality, a 23 m river bank is formed by a stratum of very fine sand and silt overlying varved silt.

Moorhouse (1938, p.4) described exposures west of Conglomerate Lake as ". . . somewhat oxidized and . . . [consisting] . . . of light-yellowish bands, one-half to 2½ inches thick, alternating with dark-buff bands having a uniform thickness of half an inch".

The topography is characterized by low relief and undulating terrain, and the soils have poor surface and internal drainage.

Where the silt and clay are thinner, they overlie ground moraine and/or bedrock. Typical map symbols which depict this terrain unit are:

$$\frac{\text{cmLP}}{\text{Lp-M}} \qquad \frac{\text{smLP}}{\text{Lu-M}} \qquad \frac{\text{smLP/tMG/R(RN)}}{\text{Lu-M}}$$

3.4.2 Significance:

RESOURCES: These glaciolacustrine sediments have little potential for sand and gravel resources. The clay and silt could possibly be used in the manufacture of tiles and brick, but the lime content may decrease their potential value. Also, there is little demand for this type of resource. Because of the uniformity of soil conditions over large areas, these landforms are amenable to forest product management.

Groundwater resources are scarce within the silt and clay strata, but aquifers may exist at depth, especially if sand and gravel overlie the bedrock.

GENERAL CONSTRUCTION: Because the soils are fine grained with a high percentage of silt, construction conditions within the glaciolacustrine plain are far from ideal. Slope instabilities along natural river banks or man-made cuts are of potential concern. While material can be excavated with ease, compaction and handling will be difficult, especially during periods of wet weather. Poor drainage and the frost-susceptible nature of the soil necessitate increased pavement thicknesses for roads. The soils could have low shear strengths; thus, foundation designs could be costly because of the lack of adequate bearing capacity.

WASTE DISPOSAL: Septic tile field designs must contend with impermeable soils and poor drainage conditions. Solid waste disposal facilities will lack suitable fill materials, and care must be taken to protect surface

waters from contamination. The disposal of liquid waste in lagoons is possible, but construction may be complicated by the wet and fine-grained nature of the soils.

3.5 ORGANIC LANDFORMS:

3.5.1 Description:

Organic terrain (OT) is found in association with sandy outwash materials and ground moraine, and to a lesser extent in lows between bedrock hills. Within these deposits, the organic peat forms a veneer over the mineral soil, and water tables are very close to, or above, ground surface. Typical symbols depicting this terrain unit are:

$$\frac{\text{pOT/sGO}}{\text{Lp-W}} \qquad \frac{\text{pOT/tMG/R(RN)}}{\text{Lu(n)-W(D)}}$$

$$\frac{\text{pOT/cmLP}}{\text{Lp-W}} \qquad \frac{\text{pOT/sGO/R(RN)}}{\text{Lu-Mh}}$$

3.5.2 Significance:

These organic landforms should be avoided by human activities. They do not constitute a resource, other than as a habitat for wildlife or as a mechanism for surface flow augmentation. Construction within the swamps would have to contend with soft and compressible soils, adverse ground water conditions, and poor access. They are poor locations for waste disposal sites.

4.0 SUMMARY OF ENGINEERING SIGNIFICANCE:

The preceeding section described the characteristics of the major landform types and the engineering and resource significance of these units. Table 1 is a summary of the general engineering significance of the more common terrain units found in the area. This table is intended only as a guide to help the reader in assessing the overall significance of the map units. Site-specific work is necessary to better define actual ground con-

ditions. Also, it must be realized that there are a number of conditions, such as drainage and slope, which are not considered in the table but which may affect the engineering significance of the various terrain units.

TABLE 1 SUMMARY OF ENGINEERING SIGNIFICANCE.

		BEDROCK		MORAINAL		GLACIOFLUVIAL			GLACIO-LACUSTRINE	OR-GANIC
		RN	RR	tMG/R	tmMG	sgGE / sgGK	sGO	sGO/tMG	cmLP	pOT
RESOURCE POTENTIAL	Sand & Gravel	Poor	Poor	Poor	Poor	Excellent	Good	Fair	Poor	N/A
	Ground Water	Poor	Poor	Poor	Fair	Fair	Good	Fair	Poor	Poor
LIGHT CONSTRUCTION CONDITIONS	Excavation	Blasting	Blasting	Fair	Good	Good	Good	Fair	Fair	Poor
	Foundation	Excellent	Excellent	Excellent	Excellent	Good	Good	Good	Poor	Very Poor
	Grading	Difficult	Difficult	Fair	Good	Good	Good	Fair	Fair	Very Poor
	Material Re-Use	Rockfill	Rockfill	Good	Good	Excellent	Excellent	Good	Poor	Very Poor
WASTE DISPOSAL SUITABILITY	Septic	Very Poor	Very Poor	Fair	Good	Fair	Good	Good	Fair to Poor	Very Poor
	Landfill	Poor	Poor	Good	Good	Fair	Fair	Fair	Fair	Very Poor
	Lagoons	Very Poor	Very Poor	Good	Excellent	Fair	Fair	Fair	Good	Very Poor

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Erratum for:

Northern Ontario Engineering Geology Terrain Study 27

JELLICOE AREA

(NTS 42E/NW)

District of Thunder Bay

page i last line of reference at bottom of page should read:

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